HEARING AID - CELLULAR PHONE INTERACTION STUDY

Hearing Aids to be included (cont'd)

New devices vs. current patients

Specific manufacturers, models, units/model

Modes of operation, frequency response tolerances, telecoil operation

HEARING AID - CELLULAR PHONE INTERACTION STUDY

Differences with respect to European tests

- Use of actual wireless phones instead of employing various RF signals provides the greatest realism in terms of actual signal structure including the format for control and voice traffic (e.g. paging, power control, channel changes).

- Subjective (Psycho-acoustic) measurements.

Subjective evaluation of wireless phone interference is important since the detectability and annoyance depend on the individual hearing acuity of each user. Both hearing aid users and those with normal hearing will be included.

HEARING-AID CELLULAR PHONE INTERACTION STUDY

Differences with respect to European Tests

- **Most Europeans and Australian Studies are for GSM phones with 2W hand portable and 8W mobile phones. OU study would involve all the NADC (North American Digital Cellular) technologies (TDMA, CDMA, and PCS)**

HEARING AID CELLULAR PHONE INTERACTION STUDY

DESIGN GROUP

- WIRELESS PHONE MANUFACTURERS
- HEARING AID COMPANIES
- HEARING AID USER GROUPS
- RESEARCHERS
- GOVERNMENT AGENCIES

October 24, 1995
Alpha by Company, then by last name

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HEARING AID DESIGN GROUP

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SHHH	Mark Ross	203-487-4727
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Southwestern Bell Mobile	Stan Sigma	214-733-2012
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UNIVERSITY OF OKLAHOMA

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OU, EE Dept.	Leon Zelby	405-325-7066

HEARING AID-CELLULAR PHONE INTERACTION STUDY

- Hosted a planning meeting for the study in Dallas, TX in May 1995 which was attended by representatives from the phone and hearing aid industries. Topics discussed included Research Study Objectives, Phone and Hearing Aid Technology Reviews, and Testing Studies completed to date;

- Completed a literature review of studies performed to date on HA interaction and international test protocols used;

- Met with the main researchers to solicit their input and include them in the testing process;

HEARING AID-CELLULAR PHONE INTERACTION STUDY

- **Formation of the HA Test Design Group to review the test protocol to be used in the study;**

- **Held two meetings of the Test Design Group to formulate the Test Protocol;**

- **Developed the draft Audiologic Protocol in Cooperation with the Hough Ear Institute in Oklahoma City;**

- **Developed the Questionnaire to be sent to HA users to select the participants for the interference tests.**

PHASE II RESEARCH OBJECTIVES

1. **Extent of the interference problems to HA users**

2. **Short term solutions to "Passer-By" interaction problems**

3. **Short term solutions to "HA User" interaction problems**

4. **Long term solutions to the "HA User" and "Passer-By" interaction problems**

5. **Effects of various phone technologies on EMI**

6. **Effects of various HA technologies on EMI**

DETAILS OF
HUMAN SUBJECTS TESTING

1. Done in cooperation with the Hough Ear Institute in Oklahoma City.
2. <u>Questionnaire</u>
   - A two-page questionnaire sent to 500 selected HA patients
   - Questionnaires will be evaluated on the basis of
     - HA Type
     - Hearing Loss Configurations
     - Severity of Loss
     - Etiology of Hearing Loss

UNIVERSITY OF OKLAHOMA
Hearing Aid - Cellular Phone Interaction study
Participant Selection Questionnaire

NAME:_____Age:_____
Last First
Address:_____

Telephone: (Home)_____(Work)_____Gender: M F

Type of Work: _____

Do you wear Hearing Aids(HA) on
Both Ears___ Left Ear only_____ Right Ear only_____

HEARING AID EXPERIENCE	DAILY HEARING AID USE	HEARING AID TYPE
___Less than 6 weeks	___Less than 1 hour per day	___Behind the ear
___6 weeks to 11 months	___1 to 4 hours per day	___In the ear
___1 to 10 years	___4 to 8 hours per day	___In the canal
___Over 10 years	___8 to 16 hours per day	___Completely in canal

Make and Model of the hearing aid you are using_____

Do you wear glasses or contact lenses for vision correction?_____

INSTRUCTIONS: Please circle the answers (A - Frequently; B - Sometimes; and C - Never) that come closest to your everyday experience for the following questions. If you have not experienced the situation we describe, try to think of a similar situation that you have been in and respond for that situation. If you have no idea, leave that item blank. Thank you.

USE OF REGULAR (CORDED) PHONES	**Frequently**	**Sometimes**	**Never**
1. I have experienced difficulties in using a phone with my hearing aids.....	A	B	C
2. I remove my hearing aids when using the phone.....	A	B	C
3. I use the telecoil mode in my hearing aids when using the phone.....	A	B	C

Comments on difficulties_____

_____

USE OF CORDLESS PHONES (These are not cellular phones.These are the portable phones in your home or office that are part of your regular phone service)

4. I have used a cordless phone..... If you have never used a cordless phone, skip to item 7.	A	B	C
5. I have experienced difficulties when using cordless phones.....	A	B	C
6. I remove my hearing aids when using cordless phones.....	A	B	C

Comments on difficulties_____

_____

_____

USE OF CELLULAR PHONES	**Frequently**	**Sometimes**	**Never**
7. I have used a cellular phone..... If you have never used a cellular phone, skip to item 10.	A	B	C
8. I have experienced difficulties when using a cellular phone	A	B	C

Comments on difficulties_____

_____

_____

9. I remove my hearing aids when I use a cellular phone.....	A	B	C
10. I have had occasions when a cellular phone was used in close proximity... If you never had such an experience, skip item 11.	A	B	C
11. I have experienced interference to my hearing aid when a cellular phone is used in close proximity...	A	B	C

List any situations that have caused interference or buzzing with the hearing aid_____

_____

_____

THANK YOU FOR COMPLETING THE SURVEY. IF YOU WOULD BE WILLING TO BE A POTENTIAL SUBJECT FOR TESTING CELLULAR PHONE INTERFERENCE WITH HEARING AIDS, PLEASE INDICATE BELOW:

_____YES _____NO

11/17/95

3. SUBJECT SELECTION

- 10 Normal Hearing Subjects
- 65 Hearing Impaired
  - Age group 18-78
  - Using hearing aids > 6 months and > 4 hours/day
  - Psychologically stable and in good health
- Four Hearing Loss Configurations based on audiograms (various etiologies will also be identified)

1. <u>Flat</u>
   - Little of no change across Speech frequencies
   - 15 Subjects (5 BTE, 5 ITE and 5 ITC)

2. Sloping
   - 5-20 dB changes per octave across speech frequencies
   - 15 subjects

3. Ski Slope
   - Normal or nearly normal thresholds 250-1000 Hz with a 30dB or more drop off in the high frequencies
   - 15 subjects

4. Rising
   - Thresholds improve 5-20dB per octave over the speech frequency range
   - 15 subjects

FAMILIAR SOUNDS AUDIOGRAM ©

NAME DATE

PITCH [Or FREQUENCY]

LOW MEASURED IN CYCLES PER SECOND HIGH

125 250 500 1000 2000 4000 8000

LOUDNESS MEASURED IN DECIBELS (dB) re:ANSI 1969

0 10 20 30 40 50 60 70 80 90 100 110 120

NORMAL LIMITS [child]

NORMAL LIMITS [adult]

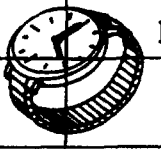
f th s

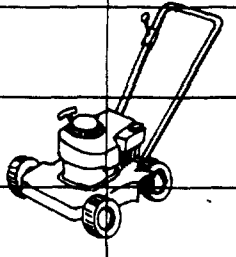
z v

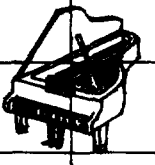
p h g ch sh k

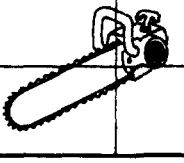
j m d b n ng e u l

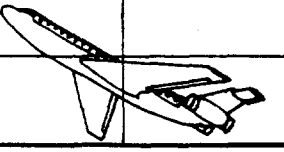
i o a r











MILD

MODERATE

MODERATELY SEVERE

SEVERE

PROFOUND

DEGREES OF HEARING

Adapted with permission of J.L.Northern and M.P.Downs from HEARING IN CHILDREN, (Williams & Wilkins, 1984)

LOUDNESS LEVELS OF COMMON SOUNDS [IN DECIBELS]

10 dB	Breathing	80 dB	Rush Hour Traffic	120 dB	Jet Airport
30 dB	Whisper	90 dB	Food Blender	140 dB	Shotgun Blast
40-60 dB	Conversation	100 dB	Train		
70 dB	Typewriter	110 dB	Chain Saw		

SHADED AREA REPRESENTS RANGE OF CONVERSATIONAL SPEECH

LDOS Familiar Sounds Audiogram Form-2, 6/84

B.A.Chaudoin, M.S.,CCC-A

To Reorder, call or write: Louisville Deaf Oral School, 414 W. Ormsby, Louisville, Ky., 40203, 1-502-636-2084

- Five completely-In-The-Canal (CIC) HA users

  (CIC's introduced recently, accounts for only 7% of the 1994 sales; hence, not very many users may be available for inclusion)

- Hearing Aid Types (Summary)

  BTE - 20 subjects
  ITE - 20 subjects
  ITC - 20 subjects
  CIC - 5 subjects

4. TESTING PROTOCOL

- Most testing will be done in the same sound attenuated test booth in the Hough Ear Institute.
- Supervised by an OU Researcher and an audiologist from Hough.
- Some testing may be done at the AT&T Lab.
- Audiograms will be done on all subjects, including those with normal hearing.
- All hearing aids will be analyzed for performance on the Fonix hearing aid test box prior to testing on the patient.

5. SUBJECTIVE TESTS

- **Phone technologies**

  - PCS 1900 MHZ (J007)
  - TDMA (D-AMPS) @800MHZ (IS-54)
  - CDMA @800MHZ (IS-95)
  - Phones with some shielding for EMI

- **Hearing Aids**

  - Subject's own HA (BTE, ITE,ITC,CIC)
  - One BTE with no shielding
  - One BTE with inside shielding
  - One BTE with outside shielding

- Both "Passer-by and "HA-user" interaction problems will be evaluated.
- Subjects will rate the annoyance level.
- Tests will estimate
  (i) the greatest distance at which interference is perceived.
  (ii) point of maximum interference.
  (iii) interference level in the normal telephone position.
- Psychophysical approach will be used for the above tests.
- Variable parameters
  - distance
  - orientation of phone
- 15 test conditions to be evaluated.

Subjective Tests (Continued)

Five Test conditions for each phone technology

(PCS @ 1900, TDMA @ 800, and CMDA @ 800)

a. Own HA in phone RF field

b. Own HA in RF field with phone shielded

c. BTE hearing aid and no shielding

d. BTE-HA with outside shielding

e. BTE-HA with inside shielding

6. OBJECTIVE TESTS

- Speech intelligibility tests using a sound field speaker, and audio taped word lists (25 words per test condition).

- Speech intelligibility scores obtained for each test condition.

- Five speech intelligibility test conditions to be evaluated.

COCHLEAR CORPORATION

Monosyllabic Word Test Key
(NU #6, List 1)
Randomization 3

PRACTICE ITEMS

1. sheep	2. cause	3. rat

TEST ITEMS

1. tough	21. raid	41. lot
2. puff	22. week	42. hurl
3. jar	23. moon	43. fall
4. met	24. burn	44. gap
5. third	25. bean	45. size
6. yes	26. knock	46. whip
7. choice	27. take	47. sell
8. jail	28. boat	48. reach
9. dime	29. hash	49. king
10. fat	30. nag	50. mode
11. laud	31. goose	
12. sure	32. vine	
13. rag	33. kite	
14. door	34. sub	
15. which	35. death	
16. shout	36. chalk	
17. keen	37. tip	
18. raise	38. limb	
19. page	39. love	
20. pool	40. home	

Objective Tests (Continued)

Five Speech Intelligibility Test Conditions

a. Own Hearing Aid and no RF field

b. Own Hearing Aid and PCS 1900 RF field

c. Own Hearing Aid and PCS 1900 with shielding

d. Own Hearing Aid and TDMA/CDMA RF field

e. Own Hearing Aid and TDMA/CDMA phone with shielding

PROJECT STATUS 11/28/95

- Questionnaire designed and is being mailed to 500 HA users

- Preliminary trials are being done with OU Personnel now (some interesting results)

- Dec. 15, 1995: Selection of 65 Hearing Aid users for testing

- Dec. 20, 1995: Testing to begin at the rate of 10 patients per week

TIME TABLE FOR RESULTS

- Jan. 15, 1996: Partial results will be available from the first 20-25 patients
- March 15, 1996: Preliminary results on all 75 Human Subject tests
- April 15, 1996: Preliminary report on
    - Extent ot the interference problems for HA users
    - Effectiveness of existing or proposed short term solutions to Hearing Aid interaction problems
- Progress reviews bi-monthly, or sooner, as significant results appear